

# PATENT ABSTRACTS OF JAPAN

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(21)Application number : 08-277149 (71)Applicant : NIPPON PAPER IND CO LTD

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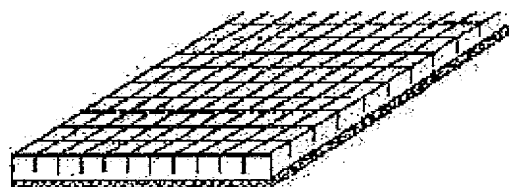
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## (54) FLEXIBLE POLYSTYRENE RESIN FOAM SHEET LAMINATE

### (57)Abstract:

PROBLEM TO BE SOLVED: To provide a polystyrene resin foam sheet laminate having strength and rigidity of necessary minimum limits and flexibility.

SOLUTION: In the polystyrene resin foam sheet laminate having polystyrene resin foam sheets each having a thickness of 1 to 4mm as a base, only the one surface has a plurality of cutouts each having a depth reaching 1/2 to 2/3 of a thickness of the base, and the other surface having no cutouts is laminated with a non-foam resin layer having a thickness of 20 to 200 $\mu$ m.



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**CLAIMS**

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[Claim(s)]

[Claim 1]Are a polystyrene-system-resin foaming sheet lamination object which uses a 1 mm - 4 mm-thick polystyrene-system-resin foaming sheet as a base, and have two or more slitting to which the depth reaches field of one of these  $1/2 - 2/3$  of thickness, and. [ of a base ] A polystyrene-system-resin foaming sheet lamination object which has pliability, wherein a field of how to twist slitting comes to laminate a 20 micrometers - 200 micrometers-thick non-foamed resin layer.

[Claim 2]A non-foamed resin layer A 20 micrometers - 70 micrometers-thick polyethylene resin film, It is the film selected from groups which consist of a polypropylene resin film, a high-impact-polystyrene resin film, and a polyethylene terephthalate resin film, A polystyrene-system-resin foaming sheet lamination object which is laminated by polystyrene-system-resin foaming sheet base by thermo compression bonding, which was indicated to claim 1 and which has pliability.

[Claim 3]A non-foamed resin layer A 20 micrometers - 70 micrometers-thick polyethylene resin film, A film selected from groups which consist of a polypropylene resin film, a high-impact-polystyrene resin film, and a polyethylene terephthalate resin film, A polystyrene-system-resin foaming sheet lamination object which is provided in a polystyrene-system-resin foaming sheet base by carrying out lamination adhesion via a thermoplastic resin layer by which melting extrusion was carried out and which has the pliability indicated to claim 1.

[Claim 4]A non-foamed resin layer resin selected from groups which consist of polyethylene resin, polypropylene resin, high-impact-polystyrene resin, and polystyrene resin, A polystyrene-system-resin foaming sheet lamination object which is a layer with a thickness of 50 micrometers - 200 micrometers laminated by melting extrusion to a polystyrene resin foaming sheet base and which has the pliability indicated to claim 1.

[Claim 5]A polystyrene-system-resin foaming sheet lamination object whose field with slitting of a polystyrene-system-resin foaming sheet is a field deeply cut after a non-foamed resin layer was provided beforehand and which has the pliability indicated they to be [ any of claims 1-4 ].

[Claim 6]A polystyrene-system-resin foaming sheet lamination object in which two or more slitting is provided at intervals of 3 mm - 20 mm and which has the pliability as which it was indicated they to be [ any of claims 1-5 ].

[Claim 7]A polystyrene-system-resin foaming sheet lamination object in which slitting was indicated to claim 6 provided in the shape of a lattice and which has pliability.

[Claim 8]A polystyrene-system-resin foaming sheet lamination object whose expansion ratio of a polystyrene-system-resin foaming sheet base is [ 5 times - ] 15 and which has the pliability indicated they to be [ any of claims 1-7 ].

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[The technical field to which an invention belongs] About the polystyrene-system-resin foaming sheet lamination object in which the non-foamed resin layer was laminated by at least one side of the polystyrene-system-resin foaming sheet, especially, neither a rolling-up peculiarity nor curl occurs, but this invention relates to the polystyrene-system-resin foaming sheet lamination object which is excellent in the pliability at the time of bending.

[0002]

[Description of the Prior Art]From points, such as adiathermancy, rigidity, \*\*\*\*\*, lightweight nature, and health nature and economical efficiency, a polystyrene-system-resin foaming sheet is fabricated by containers, such as a tray and a bowl, and the container of instant prepared food and other various containers are used in various fields at first. Since especially polystyrene system resin is a vitrified substance at ordinary temperature, the foaming sheet has very high rigidity. When a container is used, compared with other raw materials (for example, polyethylene resin, polypropylene resin, etc.), the feel when had in a hand is solid, there is the feature of giving sense of security, and it is used in large quantities in the plastic-molding field. However, the polystyrene-system-resin foaming sheet had the fault of being inferior to pliability, for this characteristic.

[0003]As a manufacturing method of such a polystyrene-system-resin foaming sheet, a manufacturing process is easy and the reason of quality being stabilized to the extrusion foam molding method is widely adopted from the former. By making the polystyrene-system-resin constituent by which melt kneading was carried out with the foaming agent etc. within the extruder breathe out in the atmosphere from an annular die orifice in this extrusion foam molding method, Form tube shape polystyrene-system-resin foam, the drum which had the inner surface of the polystyrene-system-resin foam of this tube shape [ after that ] cooled is made to contact, and it cools. Subsequently, tube shape polystyrene-system-resin foam is cleared from both sides, and a polystyrene-system-resin foaming sheet is obtained by dividing up and down and rolling round.

[0004]However, from the characteristic originating in polystyrene system resin, if the polystyrene-system-resin foaming sheet obtained here is compared with other

general-purpose resin (for example, polyethylene, polypropylene), The rigidity in ordinary temperature is high, and since a peculiarity when carrying out contact solidification, and the peculiarity at the time of rolling up are easily attached to a cooling drum, the curl centering on a flow direction and/or the curl centering on a direction right-angled to a flow direction arise.

[0005] And since rigidity was high and these peculiarities attached once could not be corrected easily, there was a fault that a polystyrene-system-resin foaming sheet was inferior in the flat nature of the sheet itself. Since it broke simply or was easy to be destroyed when this was corrected by force or was involved in the byway, there was a fault that the use range was limited.

[0006]

[Problem(s) to be Solved by the Invention] Since it was such, the polystyrene-system-resin foaming sheet had chiefly the fault that it was common that thermoforming is carried out to containers, such as a tray and a bowl, and the use range was narrow. especially -- a structural curing sheet and the object for cushioning-properties paper bags -- or, shock absorbing material, such as things which break comparatively easily, such as sheet glass, and a thing in which the surface gets damaged easily, -- or, It can hardly be used for the use of which flat nature, such as shock absorbing material, and pliability of each rolling-up state thing which made paper the start are required, but many the polyolefin system foaming sheets and polyurethane system foaming sheets which are rich in pliability chiefly are used for these uses.

[0007] Therefore, the 1st purpose of this invention is excellent in pliability, and flat nature is good, and when it bends, there is in providing the polystyrene-system-resin foaming sheet lamination object which cannot carry out a brittle fracture easily. The 2nd purpose of this invention is to cancel the fault of a polystyrene-system-resin foaming sheet, and to expand the use range.

[0008]

[Means for Solving the Problem] Many above-mentioned purposes of this invention are polystyrene-system-resin foaming sheet lamination objects which use a 1 mm - 4 mm-thick polystyrene-system-resin foaming sheet as a base, Have two or more slitting to which the depth reaches field of one of these  $1/2 - 2/3$  of thickness, and. [ of a base ] It was attained by polystyrene-system-resin foaming sheet lamination object which has pliability, wherein a field of how to twist slitting comes to laminate a 20 micrometers - 200 micrometers-thick non-foamed resin layer.

[0009] Polystyrene system resin in particular is not limited and, for example General-purpose polystyrene resin, High-impact-polystyrene system resin, styrene acrylonitrile copolymer resin, It can be used choosing suitably from styrene methylmetaacrylate copolymer resin, styrene acrylic acid copolymer resin, styrene maleic anhydride copolymer resin, these mixtures, etc.

[0010] In these polystyrene system resin, it can add according to physical properties which ask for inorganic substances, such as talc and calcium carbonate, a plasticizer, and stabilizer used as a foaming nucleating additive. It can be used choosing suitably as a foaming agent from a physical foaming agent publicly known as a foaming agent of polystyrene-system-resin foam, or a chemical foaming

agent.

[0011]As a physical foaming agent, for example Hydrocarbon compounds, such as propane, butane, hexane, and heptane, Halogenated hydrocarbon compounds, such as Freon 11, Freon 12, Freon 113, Freon 114 (Freon is a trade name of Du Pont), methyl chloride, and methylene chloride, can be mentioned. As a chemical foaming agent, combination with organic acid, such as organic system heat decomposition type blowing agents, such as azodicarbonamide, bicarbonate, citrate, etc. can be mentioned.

[0012]A sheet obtained by an extrusion foam molding method currently generally performed can be used for a polystyrene-system-resin foaming sheet which can be used by this invention. in an extrusion foam molding method -- the above-mentioned resin composition (accepting necessity -- a plasticizer.) Melt kneading of an inorganic substance and a foaming agent which are stabilizer and a foaming nucleating additive (cellular regulator) is carried out within an extruder heated by predetermined temperature, After forming polystyrene-system-resin foam in tube shape by making it breathe out in the atmosphere from an annular die orifice, a drum which had an inner surface of polystyrene-system-resin foam of this tube shape cooled is made to contact, and it cools.

[0013]Subsequently, tube shape polystyrene-system-resin foam is cleared from both sides, and a polystyrene-system-resin foaming sheet is obtained by dividing up and down and rolling round. The physical properties of this polystyrene-system-resin foaming sheet so that thickness may become a range whose expansion ratio is [ 5 times - ] 15 at 1 mm - 4 mm, adjusting extrusion conditions (manufacturing conditions, such as temperature, extruder capacity, taking over speed, and a blow up ratio) suitably -- and/or, additions, such as a foaming agent and a foaming nucleating additive, etc. can adjust.

[0014]Although pliability and flat nature which also make a simple substance the purpose by leaving a part of thickness direction to at least one field, and putting slitting into it can be given to an obtained polystyrene-system-resin foaming sheet, Alone, since a thickness part left behind by slitting becomes very thin in addition to bending strength of the foaming sheet itself being weak, a technical problem that bending strength is improved practical remains.

[0015]On the other hand, in the case of this invention, since a non-foamed resin layer is laminated by field where slitting of a form polystyrene base which has two or more slitting which amounts to  $1/2 - 2/3$  of thickness is not provided only in one field, bending nature and not only flat nature but flexural strength is enough. In this invention, a non-foamed resin layer may be laminated to both sides of a polystyrene-system-resin foaming sheet base, and slitting which amounts to  $1/2 - 2/3$  of thickness may be provided from one field. [ of a polystyrene-system-resin foaming sheet base material ] According to this invention, since pliability provided with bending strength can be given to a polystyrene-system-resin foaming sheet lamination object, a use range will be expanded to it also to a use as which flat nature which was not able to be used conventionally is required, a use comparatively rolled round to a byway, etc.

[0016]Although a polystyrene-system-resin foaming sheet used by this invention is 1 mm - 4 mm in thickness and the expansion ratio is [ 5 times - ] 15, this takes

into consideration adiathermancy, buffer nature, intensity, a use, etc. which are the features of a polystyrene-system-resin foaming sheet. A non-foamed resin layer used by this invention needs to be 20 micrometers – 200 micrometers from a viewpoint of economical efficiency in order to maintain sufficient bending strength. [0017]In composite-ization which laminates a polystyrene-system-resin foaming sheet and a synthetic resin non-foamed resin layer. What is called a heat lamination method stuck by pressure between hot calender rolls generally used, and what is called a sand lamination method that carries out adhesion lamination of a polystyrene-system-resin foaming sheet and the synthetic resin non-foamed resin layer via a thermoplastic resin layer by which melting extrusion was carried out -- or, Any of an extrusion lamination method which carries out melting extrusion of the non-foamed resin layer directly, and laminates it to a polystyrene-system-resin foaming sheet base may be adopted.

[0018]In this invention, slitting to a polystyrene-system-resin foaming sheet, What is called a die roll method using a roll which has an edge after providing a non-sparkling resin layer in at least one field of a polystyrene-system-resin foaming sheet base first and considering it as a layered product, Or it is carried out by putting in slitting which amounts to  $1/2 - 2/3$  of a base by publicly known methods, such as a slitting machine method using a clicking machine, a round tooth, or a leather edge using a board-shaped object which has an edge. This slitting gives pliability and also it is preferred that that interval shall be 20 mm or less from from or to be referred to as 3 mm – 20 mm if intensity is considered although it is desirable.

[0019]The slitting depth was made into the above-mentioned range in order to give sufficient pliability, while suppressing a fall of bending strength and overall intensity as much as possible. If the slitting depth is deep, strength reduction will become remarkable, and sufficient pliability cannot be acquired if shallow. Naturally slitting at the time of providing a non-sparkling resin layer only in one field of a polystyrene-system-resin foaming sheet base is provided from a side by which a non-sparkling resin layer is not laminated. A slitting pattern put into the surface of a polystyrene-system-resin foaming sheet lamination object of this invention is arbitrary.

[0020]A synthetic resin film used as a non-foamed resin layer when using a heat lamination method or a sand lamination method, A polyethylene resin film, a polypropylene resin film, a high-impact-polystyrene resin film, a polyethylene terephthalate resin film, etc. are preferred. This can stop strength reduction by providing slitting of a polystyrene-system-resin foaming sheet as much as possible from the strength property of these films, and also it is because it is a film of flexibility, so it can obtain easily, and it is cheap and a jump of a manufacturing cost can be prevented.

[0021]As a thermoplastic resin layer used by a sand lamination method, or a non-sparkling resin layer used by an extrusion lamination method, polyethylene resin, polypropylene resin, high-impact-polystyrene resin, polystyrene resin, etc. are preferred. This is because these resin has the characteristic that an adhesive property with a substrate is fully securable using general-purpose extrusion equipment and can manufacture a foaming sheet lamination object easily.

[0022]Pliability said by this invention evaluates the extent by making a "deflection" into an index. That is, a sample is used as a long \*\* object (2 cm x 10 cm), 0.1 kg of load is put at a tip, and deflection distance at a tip when a beam length of 5 cm is made into a fulcrum from a tip is measured and evaluated. It bends as a rigid high thing (that in which pliability is inferior), there is little distance, when pliability increases, it bends, and distance becomes large. Flat nature said by this invention evaluates a grade by which modification of curl etc. is canceled, when a sheet sample of a 50-cm angle is settled on an even place.

[0023]

[Embodiment of the Invention]The polystyrene-system-resin foaming sheet lamination object of this invention to at least one field of a 1 mm - 4 mm-thick polystyrene-system-resin foaming sheet. It can manufacture by laminating a 20 micrometers - 200 micrometers-thick non-foamed resin layer by the heat lamination process, a sand lamination process, or melting extrusion, and subsequently to 1 / 2 - 2/3 of the thickness putting two or more reaching slitting into said polystyrene-system-resin foaming sheet.

[0024]

[Effect of the Invention]The polystyrene-system-resin foaming sheet lamination object of this invention, Since pliability can be given and stress can be removed from the surface, maintaining the minimum intensity required for a polystyrene-system-resin foaming sheet, and rigidity, and the appearance fault by curl etc. is canceled and it excels in flat nature, Expansion of the use range of the field which was not able to be used in usual is expected. Since this raises the utility value as a polystyrene-system-resin foaming sheet lamination object, this invention brings about reduction of waste and can contribute also to environmental protection by extension.

[0025]

[Example]Hereafter, this invention is not limited by this although this invention is further explained in full detail according to an example.

To one field of the foaming sheet which consists of polystyrene resin 9.8 times the expansion ratio [ example 1.2.2 mm in thickness, and ] of this. Adhesion lamination (heat lamination method) of the film which comprises 30-micrometer-thick polystyrene resin was carried out by thermo compression bonding using the roll heated by the skin temperature of about 150 \*\*, and the composite sheet was manufactured.

[0026]Subsequently, at intervals of 10 mm, 1.4-mm-deep slitting was put in the shape of a lattice into the surface by the side of the foaming sheet of this composite sheet (side by which the polystyrene resin layer is not laminated), and the polystyrene-system-resin foaming sheet lamination object of this invention was acquired on it. Although the curl attached at the time of rolling up remained and the polystyrene-system-resin foaming sheet lamination object before putting in slitting was inferior in appearance, what put in slitting was a sheet which can take curl and is rich in flat nature. The "deflection" used as the index of pliability is 30 mm, and it is distinct that pliability has been improved compared with 3 mm of the conventional sheet before putting in slitting.

[0027]The interval of example 2. slitting was 5 mm, and also the polystyrene-



system-resin foaming sheet lamination object of this invention was acquired completely like Example 1. As for the acquired polystyrene-system-resin foaming sheet lamination object, like the thing of Example 1, flat nature is good, and also the "deflection" was set to 50 mm and pliability was further improved from the case of Example 1.

The foaming sheet which consists of polystyrene resin 11.8 times the expansion ratio [ example 3.3.8 mm in thickness, and ] of this was used, and also the composite sheet was manufactured completely like Example 1. Subsequently, 2.4-mm-deep slitting was put into the surface by the side of the foaming sheet of this composite sheet in the shape of a lattice at intervals of 10 mm, and the polystyrene-system-resin foaming sheet lamination object of this invention was acquired. The acquired polystyrene-system-resin foaming sheet lamination object is excellent in flat nature like Example 1.

As for the "deflection", 22 mm and pliability are improved.

[0028]The foaming sheet which consists of polystyrene resin 10.0 times the expansion ratio [ example 4.1.4 mm in thickness, and ] of this was used, and also the composite sheet was manufactured like Example 1. Subsequently, at intervals of 10 mm, 0.7-mm-deep slitting was put in the shape of a lattice into the surface by the side of the foaming sheet of this composite sheet, and the polystyrene-system-resin foaming sheet lamination object of this invention was acquired on it. The acquired polystyrene-system-resin foaming sheet lamination object is what is excellent in flat nature like Example 1, and also the "deflection" was very large and was not able to be measured.

[0029]To one field of the foaming sheet which consists of polystyrene resin 9.8 times the expansion ratio [ example 5.2.2 mm in thickness, and ] of this. Adhesion lamination (sand lamination method) of the film which consists of 30-micrometer-thick polystyrene resin was carried out via the high-impact-polystyrene resin by which melting aggressiveness appearance was carried out, and the composite sheet of the three-tiered structure was manufactured. The thickness of high-impact-polystyrene resin at this time was 100 micrometers. Subsequently, slitting was put into the surface by the side of the foaming sheet of this composite sheet like Example 1, and the polystyrene-system-resin foaming sheet lamination object was acquired. The flat nature of the acquired polystyrene-system-resin foaming sheet lamination object is good, and 23 mm and pliability have been improved for the "deflection."

[0030]To one field of the foaming sheet which consists of polystyrene resin 9.8 times the expansion ratio [ example 6.2.2 mm in thickness, and ] of this, melting extrusion of the high-impact-polystyrene resin was carried out at a thickness of 150 micro, it was laminated (extrusion lamination method), and the composite sheet was manufactured. Subsequently, slitting was put into the surface by the side of a foaming sheet like Example 1, and the polystyrene-system-resin foaming sheet lamination object was acquired. The flat nature of the acquired polystyrene-system-resin foaming sheet lamination object is good, and the "deflection" was extremely rich in pliability with 30 mm.

[0031]Comparative example 1. slitting could not be entered, and also the lamination

layer sheet was manufactured completely like Example 1. The curl attached at the time of rolling up remains, and the acquired polystyrene-system-resin foaming sheet lamination object is inferior in appearance.

Although correction of curl was tried compulsorily, it cannot cancel at all, but it is inferior to flat nature.

Stiffness of the "deflection" was very as high as 3 mm, and most pliability was not acquired.

[0032]Comparative example 2. slitting could not be entered, and also the lamination layer sheet was obtained completely like Example 5. The curl attached at the time of rolling up remains, and the acquired polystyrene-system-resin foaming sheet lamination object is inferior in appearance. Although curl correction was tried compulsorily, it cannot cancel at all but is inferior to flat nature. Stiffness of the "deflection" was very as high as 1 mm, and most pliability was not acquired.

[0033]1.1-mm-deep slitting was put into one field of the foaming sheet which consists of polystyrene resin 9.8 times the expansion ratio [ 2.2 mm in thickness, and ] of this used in comparative example 3. example 1 in the shape of a lattice at intervals of 10 mm, and the slitting article of the polystyrene-system-resin foaming sheet simple substance was obtained. Before the obtained polystyrene-system-resin foaming sheet simple substance put in slitting, the curl which was rolled round and was sometimes attached remained, and it was inferior in appearance, but what put in predetermined slitting is a sheet which can take curl and is rich in flat nature.

Pliability was also fully given.

However, for causing and using strength reduction to the extent that sheet destruction is caused, it was unsuitable at the time of the "deflection" evaluation used as the index.

[0034]Using the composite sheet of the two-layer structure acquired by making it be the same as that of the comparative example 4. example 1, slitting was put in like Example 1 and the depth was 1.8 mm. The obtained lamination layer sheet was unsuitable for causing and using strength reduction to the extent that sheet destruction is caused like the case of the comparative example 3 at the time of "deflection" evaluation, although it excelled in flat nature and pliability was also enough.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1]It is a perspective view showing the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 2]It is a cross section mimetic diagram showing each example of the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 3]It is a cross section mimetic diagram showing each example of the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 4]It is a cross section mimetic diagram showing each example of the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 5]It is a mimetic diagram of the slitting pattern put into the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 6]It is a mimetic diagram of the slitting pattern put into the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 7]It is a mimetic diagram of the slitting pattern put into the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 8]It is a mimetic diagram of the slitting pattern put into the polystyrene-system-resin foaming sheet lamination object of this invention.

[Drawing 9]It is a mimetic diagram of the slitting pattern put into the polystyrene-system-resin foaming sheet lamination object of this invention.

[Description of Notations]

- 1 Polystyrene-system-resin foaming sheet
- 2 Synthetic resin film
- 3 Thermoplastic resin layer
- 4 Slitting

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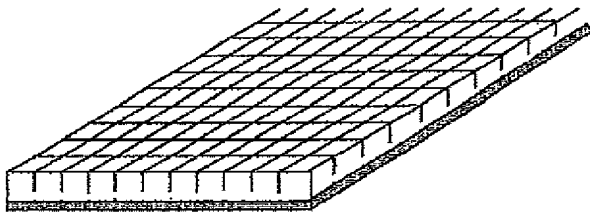
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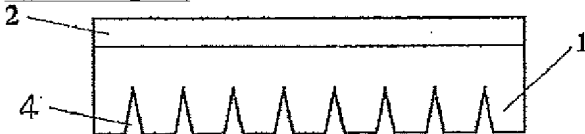
**DRAWINGS**

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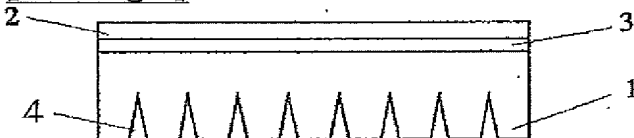
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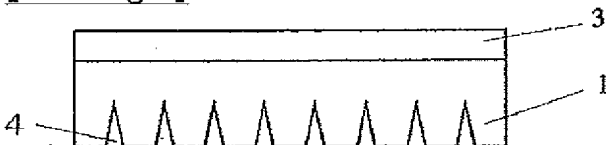
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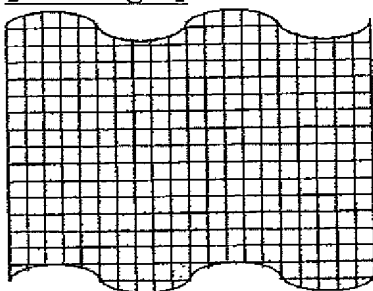
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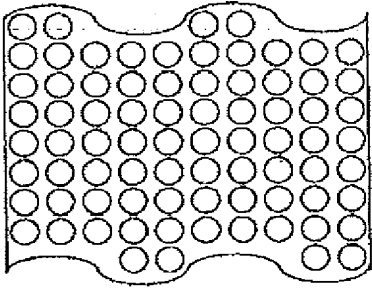
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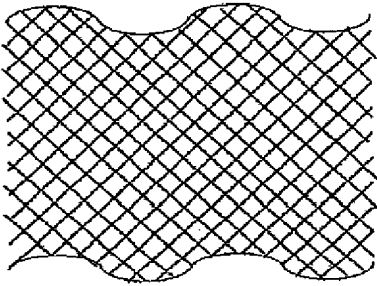
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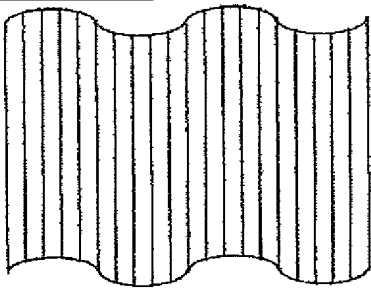
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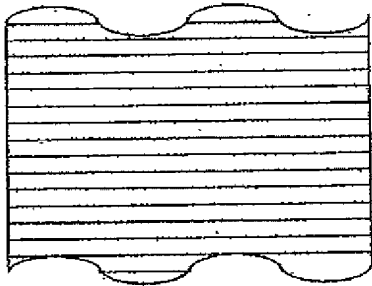
[Drawing 7]



[Drawing 8]



[Drawing 9]



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